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Indian Standard

SPECIFICATION FOR LEAD-ACID BATTERIES FOR ELECTRIC LOCOMOTIVES AND ELECTRICAL MULTIPLE UNITS

(First Revision)

First Reprint AUGUST 1998

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NEW DELHI 110002

Gr 4

October 1989

Indian Standard

SPECIFICATION FOR LEAD-ACID BATTERIES FOR ELECTRIC LOCOMOTIVES AND ELECTRICAL MULTIPLE UNITS

(First Revision)

0. FOREWORD

0.1 This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards on 25 October 1988 after the draft finalized by the Secondary cells and Batteries Sectional Committee had been approved by the Electrotechnical Division Council.

0.2 This standard deals with the methods of tests, performance and other requirements for lead-acid storage batteries used as a source of energy for lighting and other normal auxiliary purposes for electric locomotives and electrical multiple units. It does not cover batteries for train lighting and airconditioning of railway coaches which are covered by IS : 6848-1969*.

0.3 The revision of this standard has been undertaken to bring it in line with the latest developments.

0.4 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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*Specification for lead-acid batteries for train lighting and airconditioning services (*first revision*).

*Rules for rounding off numerical values (*revised*).

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1. SCOPE

1.1 This standard covers the method of tests, performance and other requirements for lead-acid storage batteries used as a source of energy for lighting and other normal auxiliary purposes for electric locomotives and electrical multiple units.

1.2 It does not cover batteries for train lighting and airconditioning of railway coaches which are covered by IS : 6848-1979*.

2. TERMINOLOGY

2.0 For the purpose of this standard, the definitions given in IS : 1885 (Part 8) - 1986† in addition to the following, shall apply.

2.1 Battery Unit — A number of cells assembled in a monobloc container.

2.2 Battery — Two or more battery units (*see* **2.1**) connected in series.

2.3 Nominal Reserve Capacity (in Time) — It is the period during which a battery can supply a fixed current down to a specified end voltage.

2.4 Type Tests — Tests carried out to prove conformity with the requirements of this standard. These are intended to prove the general quality and design of a given type of battery.

2.5 Acceptance Tests — Tests carried out on samples selected from a lot for the purpose of verifying the acceptability of the lot.

2.5.1 *Lot* — All batteries (*see* **2.2**) of the same type, design and rating, manufactured by the same factory during the same period using the same process and materials offered for inspection at a time constitute a lot.

3. MATERIALS AND CONSTRUCTION

3.1 General — The battery shall comprise 50 cells in 10 battery units, each battery unit being of 5 cells and shall normally be floating on 110V changing circuit.

NOTE — For replacement purposes where 5 cells monobloc cannot be accommodated, details of monobloc of different configuration and dimensions may be furnished by the purchaser.

3.2 Inter-Unit Connector — The inter-unit connector shall be of the following type :

Flexible single core cables.

3.2.1 Inter-unit connector shall be suitably insulated and protected from acid fumes. The inter-unit connector shall conform to Fig. 1.

3.2.2 Terminal bolts, nuts and washers shall be lead-coated and shall be in accordance with Fig. 2.

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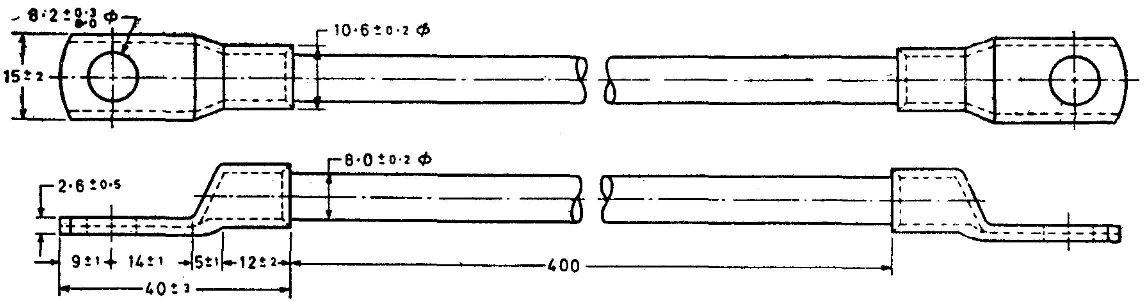
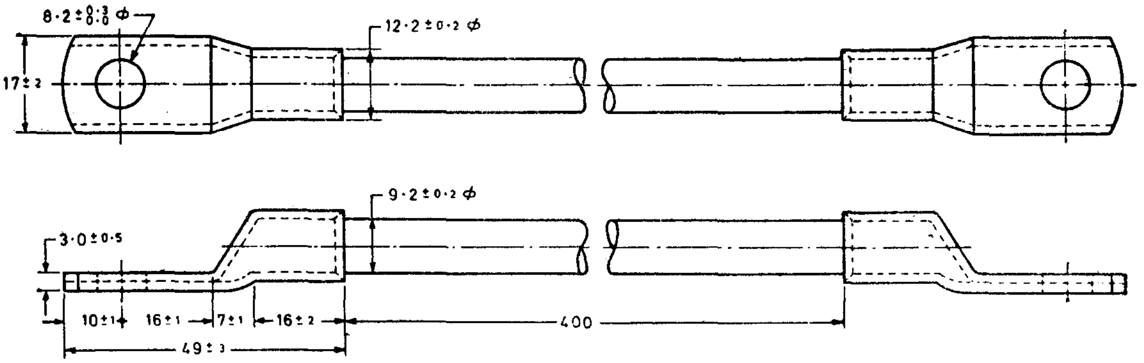
*Specification for lead-acid batteries for train lighting and airconditioning services (*first revision*).

†Electrotechnical vocabulary : Part 8 Secondary cells and batteries (*first revision*).



All dimensions in millimetres.
35 mm² Copper Conductor PVC Cable
Material : Electrolytic Copper
Finish : Lead Coating of 0·075 mm Thickness



All dimensions in millimetres.
50 mm² Aluminium Conductor PVC Cable
Material : Electrolytic Copper
Finish : Lead Coating of 0·075 mm Thickness

FIG 1. INTER UNIT CONNECTOR

3.3 Container and Lid — The battery unit shall be assembled in a monobloc rubber or plastic container conforming to IS : 1146-1972*.

NOTE — Other types of containers shall be agreed between the manufacturer and the purchaser.

3.3.1 *Cell Lids* — Cell lids shall be either drop-on type together with suitable rubber gasket or of deep-sealing type suitable for use with bituminous sealing compound, with close fitting terminal post outlets. The vent plug and/or float guide diameter shall be 27 mm with pitch thread of 3 mm as specified in IS : 4218†.

3.3.2 Each cell shall be provided with a suitable separator guard, adequately secured to prevent damage to separators while inserting thermometers or service apparatus into a cell.

3.4 Separators — The separators used shall conform to IS : 6071-1970‡.

3.5 Venting Device — The venting device shall be of the anti-splash type and shall allow the gases to escape freely but shall effectively prevent acid particles or spray from coming out. Provision shall be made for drawing electrolyte samples, checking and servicing of the electrolyte.

3.6 Electrolyte — The sulphuric acid and water used as electrolyte in the battery unit shall conform to IS : 266-1961* and IS : 1069-1964†, respectively.

3.6.1 The height of electrolyte above the top of the separators in fully topped condition shall not be less than 40 mm.

3.6.2 For the purpose of tests and services, the specific gravity of electrolyte in fully charged condition corrected to 27°C shall be between 1·240 and 1·250.

3.6.3 After a full charge, the specific gravity and temperature of the electrolyte shall be measured and the specific gravity corrected to 27°C using the formula :

$$SG_{27} = SG_t + 0·000\,7\,(t - 27)$$

where

SG_{27} = specific gravity at 27°C,
SG_t = specific gravity at t°C, and
t = temperature of the electrolyte.

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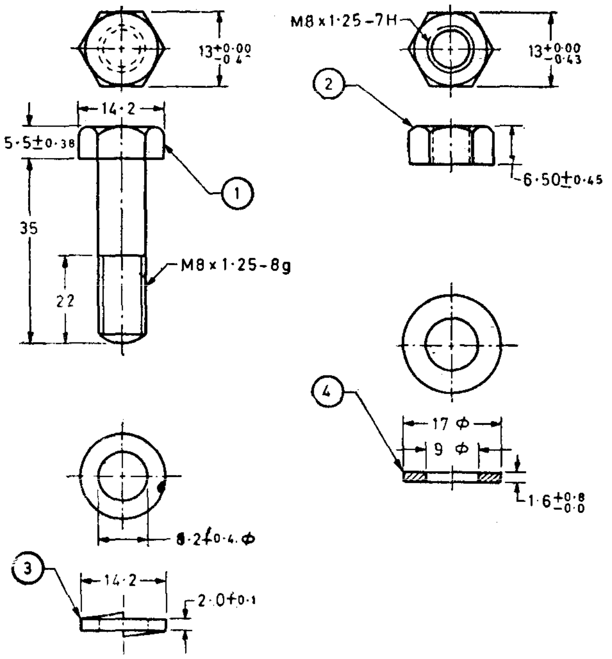
*Specification for rubber and plastic containers for lead-acid storage batteries (*first revision*).

†ISO metric screw threads (*first revision*).

‡Specification for synthetic separators for lead-acid batteries.

*Specification for sulphuric acid (*revised*).

†Specification for water for storage batteries (*revised*).



Part No. (1)	Description (2)	Material Specification (3)	Material (4)	Dimensional Specification (5)
1	Hex Bolt M8 × 35 — IS : 1363†	IS : 1367*	Free cutting steel	IS : 1363†
2	Hex Nut M8 — IS : 1363†	IS : 1367*	Free cutting steel	IS : 1363†
3	Spring Washer A 8 — IS : 3063§	IS : 4072‡	Spring steel or EN 42 steel	IS : 3063§
4	Punched Washer as IS : 2016¶, steel	IS : 513‖	Cold rolled steel, dead soft	IS : 2016¶

Note — Thickness of lead components shall not be less than 0·01 mm. After lead coating, threads of nut and bolt shall not transgress the maximum material limits for position H or h referred in IS : 4218**.

*Technical supply conditions for threaded fasteners (*second revision*).

†Hexagon head bolts, screws and nuts of product grade C.

‡Specification for steel for spring washers (*first revision*).

§Specification for single coil rectangular section spring washers for bolts, nuts and screws (*first revision*).

‖Cold rolled low carbon steel sheets and strips (*third revision*).

¶Specification for plain washers (*first revision*).

**ISO metric screw threads.

All dimensions in millimetres.

Fig. 2 Terminal Bolts, Nuts and Washers for Inter Unit Connectors

3.7 Sealing Compound — Sealing compound, if bitumen based, shall conform to IS : 3116 - 1965*.

4. RATING, CAPACITY, OVERALL DIMENSIONS AND WEIGHT

4.1 The rating assigned to the battery shall be the capacity expressed in ampere-hours (after correction to 27°C) stated by the manufacturer to be obtainable when the battery is discharged at the 5-hour rate in accordance with **6.6**.

4.2 Capacities of the batteries shall be as given in col 1 of Table 1. Overall dimensions and the weight of each battery unit shall not be more than those indicated in Table 1 for the respective capacity of the battery (*see also* Note under **3.1**).

5. MARKING

5.1 Each battery unit shall have the following details durably marked:

a) Manufacturer's brand name,
b) Month and year of manufacture,
c) Capacity,
d) Manufacturer's type number,
e) Specific gravity, and
f) Country of manufacture.

5.2 Manufacturer shall provide space on the inter-cell connector to enable the purchaser to stamp the date of commissioning of the battery unit.

5.3 The battery unit may also be marked with the Standard Mark.

Note — The use of the Standard Mark is governed by the provisions of the Bureau of Indian Standards Act, 1986 and the Rules and Regulations made there-

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*Specification for sealing compound for lead-acid batteries.

TABLE 1 DIMENSIONS AND WEIGHT OF THE BATTERY UNIT

[*Clauses* 4.2 *and* D-1 (e)]

Capacity at 5-Hour Rate of Discharge	Overall Dimensions			Weight per Battery Unit with Electrolyte	Recommended for Type of Electric Locomotive or Electrical Multiple Unit
	Length	Width	Height		
(1)	(2)	(3)	(4)	(5)	(6)
Ah	mm	mm	mm	kg	
75	356	172	360	47	WAM1, WAM2, WAM3, WAG1, WAG2, WAG3, WCM4, WCG2, WAM4, WCU8, WCU9, WCU11, WCU12, WCU14, WCAU1, WCU13,
90	356	172	360	50	WAG4, WAU3, WAU4, YAU1, WCM3 (Converted) WCM3, WCM5

under. The Standard Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by BIS and operated by the producer. Standard marked products are also continuously checked by BIS for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

6. TESTS

6.1 Classification of Tests

6.1.1 *Type Tests* — The tests given in **6.1.1.1** shall constitute the type tests.

6.1.1.1 *Sequence of tests and samples* — The samples shall be drawn at random by the testing or inspecting authority. Six samples shall be tested. The sequence of tests shall be as indicated in the schedule below:

Tests	*Battery Unit Number*					
	1	2	3	4	5	6
a) Physical examination (**6.4**)	×	×	×	×	×	×
b) Air pressure test (**6.5**)	×	×	×	×	×	×
c) Test for capacity (**6.6**)	×	×	×	×	×	—
d) Ah and Wh efficiency test (**6.7**)	—	—	×	×	—	—
e) Test for retention of charge (**6.8**)	—	—	×	×	—	—
f) Life test (**6.9**)	×	×	—	—	—	—
g) Storage test (**6.10**)	—	—	—	—	—	×
h) Electrolyte retention test (**6.11**)	—	—	—	—	×	—
j) Vibration resistance test (**6.12**)	—	—	—	—	×	—

NOTE — The battery shall be covered by type approval certificate from an appropriate authority. Significant variations in design shall be covered by separate type approval certificates. The battery of new design shall be prototype tested for which samples offered by the manufacturer shall be accepted. For type test, samples drawn from mass production at random shall be retested after 3 years. In case of unsatisfactory performance of batteries, type testing can be repeated earlier at the discretion of the approving authority.

6.1.1.2 If any of the samples fail in the relevant type test, the testing authority may call for fresh samples not exceeding twice the original number and subject them again to the test(s) in which failure occurred. If there is any failure in the retest(s), the type shall be considered as not having passed the requirements of this standard.

6.1.2 *Acceptance Test* — For acceptance test, rated Ah capacity test at 5-hour rate shall be conducted (*see* **6.6**).

6.1.3 *Sampling Scheme and Criteria for Acceptance*

6.1.3.1 *Scale of sampling* — The number of batteries to be selected at random from the lot shall be in accordance with the col 1 and 2 of Table 2.

In order to ensure the randomness for selection, random number tables shall be used (*see* IS : 4905-1968*).

The batteries selected shall be subjected to the acceptance test specified in **6.1.2**.

Each of the battery selected in the first stage in accordance with col 2 of Table 2 shall be tested for acceptance. A battery shall be declared defective if it fails in the acceptance test. If the number of defectives is less than or equal to C_1, the lot shall be considered as conforming to the requirements of the standard. If the number of defectives is equal to or greater than C_2, the lot shall be considered as not conforming to the requirements of the standard. If the

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*Method for sampling.

TABLE 2 SAMPLE SIZE AND CRITERION FOR CONFORMITY

(*Clause* 6.1.3.1)

LOT SIZE *N* (1)	FIRST STAGE *n* (2)	SECOND STAGE *n* (3)	2*n* (4)	C_1 (5)	C_2 (6)	C_3 (7)
Up to 50	2	2	4	0	1	1
51 to 300	3	3	6	0	1	1
301 to 500	5	5	10	0	2	2
501 to 1 000	8	8	16	0	2	2
1 001 and above	13	13	26	0	3	4

number of defectives in the first stage is less than C_2 and greater than C_1, a further sample of same size as taken in the first stage shall be taken and tested. If the number of defectives in the two samples combined is less than C_3, the lot shall be considered as conforming to the requirements of the standard otherwise the lot shall be considered as not conforming to the requirements of the standard.

6.2 Temperature for Tests — Unless otherwise specified, the temperature for tests shall be maintained between 20 and 30°C.

6.3 Equipment and Instruments

6.3.1 *Voltmeter* — The voltmeter used for test shall be of an accuracy class not inferior to 1·0 in accordance with IS : 1248 (Part 2)-1983. The resistance of the voltmeter used shall be at least 300 ohms per volt [*see* also IS : 1248 (Part 3)-1983*]. The range of voltmeter used shall be appropriate for the magnitude of voltage to be measured.

6.3.2 *Ammeter* — The ammeter used for tests shall have an accuracy class not interior to 1·0 [*see* also IS : 1248 (Part 2)-1983† and IS : 1248 (Part 3)-1983*]. The range of ammeter used shall be appropriate for the magnitude of the current to be measured.

6.3.3 *Thermometer* — Thermometers with an appropriate scale shall be used for measuring temperatures, and one division of the graduated scale shall represent at the most 1°C. The accuracy of the calibration shall be not less than 0·5°C.

NOTE — The voltmeter, the ammeter and thermometer of digital read-out type of similar accuracy also can preferably be used. Chart recorders shall be used for life cycle testing.

6.3.4 *Hydrometer* — The specific gravity of the electrolyte shall be measured by hydrometers provided with a graduated scale, one division of which shall represent at the most 0·01 unit of specific gravity. The hydrometer shall be accurate to within ± 0·01 unit of specific gravity.

6.4 Physical Examination — The batteries shall be examined for conformity with the requirements of **5**.

6.5 Test for Air Pressure — The sealing of each cell of the battery shall be checked by compressed air at a pressure equal to 700 mm of water. The volume of tubes and auxiliary parts in connection with the cell under pressure shall not exceed 0·5 litre Air pressure in the cell shall be noted 15 seconds after the supply has been disconnected and it shall not fall below 670 mm of water.

6.6 Test for Capacity — The capacity at 5-hour rate of discharge when tested in the manner prescribed in Appendix A shall be not less than the capacity declared by the manufacturer.

6.7 Test for Ampere-Hour and Watt-Hour Efficiency — Ampere-hour and watt-hour efficiencies when tested as described in Appendix B shall be not less than 90 and 75 percent, respectively.

6.8 Test for Retention of Charge — The object of this test is to determine the loss of capacity of a battery unit on open circuit during specified period.

6.8.1 The battery unit shall be fully charged at the normal charging current specified by the manufacturer and it shall then be subjected to two consecutive capacity test discharges in accordance with **6.6**, the value of the initial capacity, *C* being calculated as the mean of two results thus obtained.

6.8.2 After a complete recharge and after clearing of the electrolyte from the surface, the battery unit shall be left on open circuit for a period of 28 days without disturbance at a temperature of 27 ± 2°C.

6.8.3 After 28 days storage, the battery unit shall be discharged in accordance with **6.6**. The value of the capacity measured after storage shall be denoted by C_1.

6.8.4 After the discharge, the battery unit shall be fully charged at the normal charging rate recommended by the manufacturer.

6.8.5 The loss of capacity *S*, expressed as a percentage, shall be calculated from the formula:

$$S = \frac{C - C_1}{C} \times 100$$

6.8.6 *Requirement* — The loss of capacity calculated as in **6.8.5** shall not be more than 20 percent.

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*Specification for direct acting indicating analogue electrical measuring instruments and their accessories: Part 2 Ammeters and voltmeters (*second revision*).

†Specification for direct acting indicating analogue electrical measuring instruments and their accessories: Part 3 Wattmeters and varmeters (*second revision*).

6.9 Life Test

6.9.1 The battery unit shall be subjected to 10 units of life test as prescribed in Appendix C.

6.9.2 The duration of rapid discharge of each test unit under the conditions prescribed in **C-5** shall not be less 25 minutes.

6.10 Test for Storage — The battery unit shall be capable of being stored unfilled for a period of 24 months from the date of manufacture. After storage for the specified period, the battery unit shall satisfy the requirement of capacity test (*see* **6.6**).

6.11 Electrolyte Retention Test — The ability of a battery to retain the electrolyte in various critical positions.

6.11.1 The test is carried out on a fully-charged battery.

6.11.2 The battery is allowed to stand on open circuit for a period of 4 h.

6.11.3 The electrolyte level in each cell is again adjusted, if necessary.

6.11.4 The battery is then charged at a current 0·1 of nominal capacity for a period of 30 minutes. All surfaces are then cleaned to remove any electrolyte.

6.11.5 The battery is then tilted in the forward, backward, and both side directions at intervals of not less than 30 seconds between each tilting, under the following conditions:

a) The battery is tilted through 0·5 radian from the vertical during a maximum period of 1 s,

b) The battery is maintained in this position for 3 s, and

c) The battery is restored to vertical position during a maximum period of 1 s.

6.11.6 The test carried out in accordance with **6.11.5** shall be completed within a period of 15 minutes after the termination of charging period in accordance with **6.11.4**.

6.11.7 There shall be no electrolyte visible on the external surface of the battery or its terminals and caps.

6.12 Vibration Resistance Test — The test shall be performed in accordance with IS : 9000 (Part 8)-1981*. The samples shall be first tested for capacity test as given in **6.6** before putting into vibration test. The test consists in vibrating the batteries at a frequency of 16 Hz with a total displacement of 5 mm for a period of 2 hours. During the vibration, the batteries shall be discharged at the 5 h rate.

6.12.1 *Requirements* — There shall be not any sudden drop either in the current of voltage values and there shall be no spillage of electrolyte during the test.

7. DATA FROM THE MANUFACTURER

7.1 The manufacturer along with the quotation or supply shall provide the information given in Appendices D and E.

8. MANUAL OF INSTRUCTIONS

8.1 The manufacturer shall supply one copy of the instruction manual for initial treatment and routine maintenance on service with every batch of 10 sets or a part thereof, ordered.

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*Basic environmental testing procedures for electronic and electrical items: Part 8 Vibration (sinusoidal) test.

APPENDIX A

(*Clause* 6.6)

TEST FOR CAPACITY AT THE 5-HOUR RATE

A-1. Battery shall be charged in accordance with the manufacturer's instructions. The discharge shall commence not less than 12 hours and not more than 24 hours from the completion of a full charge and the battery unit shall be discharged through a suitable resistance at a current $I = 0{\cdot}2 \times C_5$ amperes, C_5 being the rated capacity.

The discharge shall be stopped when the closed circuit voltage across the terminals falls to 1·70 V × n where n is the number of cells in series per battery unit.

If, however a test discharge cannot be conducted within the specified rest period due to any exigencies, a freshing charge may be given to the cell/battery at the finishing rate of charge recommended by the manufacturer for a period of 1 hour after every 24 hours or a part thereof, of extended rest period. The capacity test, however, can be started after a minimum period of two hours elapsing after this freshening charge.

A-2. At that rate of discharge, hourly voltage readings may be taken until the battery unit terminal voltage approaches 1·80 V × n after which the reading shall be taken every 15 minutes until the battery terminal voltage falls to 1·70 V × n.

A-3. On the first discharge, the battery unit shall give not less than 85 percent of the rated capacity C_5 and the rated capacity shall be reached within 10 discharge cycles subsequent to the initial charge.

NOTE — The test shall be deemed to be completed at the end of the discharge cycle in which the capacity obtained equals or is above the rated capacity.

A-4. The battery unit shall be charged at the normal charging rate as recommended by the manufacturer immediately after each discharge.

A-5. The time in hours that has elapsed between the beginning of the discharge until the battery unit terminal voltage has fallen to $1{\cdot}70\ \text{V} \times n$ shall be taken as the period of discharge.

A-6. The capacity in ampere-hours shall be obtained by multiplying the discharge current by the total time of discharge in hours and the product so obtained shall be corrected to a temperature of 27°C by the following formula:

$$C_{27} = \frac{C_t}{1 + K(t - 27)}$$

where

k = 0·004 3 for tubular positive plates and for pasted positive plates,

C_{27} = Ah capacity at an average eleetrolyte temperature of 27°C,

C_t = Ah capacity obtained at an average electrolyte temperature of t°C, and

t = average temperature of electrolyte during discharge (mean value of initial and final temperature).

APPENDIX B

(*Clause* 6.7)

PROCEDURE FOR MEASURING AMPERE-HOUR AND WATT-HOUR EFFICIENCY

B-1. The following method shall be used for determining the maximum ampere-hour and watt-hour efficiencies:

a) *Ampere-Hour Efficiency* — A fully charged battery shall be discharged at $I = 0{\cdot}2 \times C_5$-amperes to a closed circuit voltage across the battery terminals of $1{\cdot}70\ \text{V} \times n$, careful measurements being made of the exact number of ampere-hours delivered. On recharge the same number of ampere-hours are put back at the same current. A second discharge shall then be made to the same closed circuit voltage as before. The efficiency of the battery is then calculated as the ratio of the ampere-hour delivered during the second discharge corrected to 27°C to the ampere-hour put in during the charge.

b) *Watt-Hour Efficiency* — The watt-hour efficiency shall be calculated by multiplying the ampere-hour efficiency with the ratio of average discharge and recharge votlages. The values of discharge and recharge voltages shall be calculated from the log sheets for ampere-hour efficiency.

APPENDIX C

(*Clause* 6.9.1)

LIFE TEST

C-1. The life of battery unit is defined by the number of life test units obtained under the following conditions.

C-2. The life test is carried out on two battery units which have satisfactorily passed the test in accordance with **6.4**, **6.5** and **6.6**.

C-3. The battery unit is to be fully charged. When fully charged, the level and specific gravity of the electrolyte of each cell shall be checked and if necessary, adjusted.

C-4. The battery unit shall then be subjected to a series of charges and discharges continuously. The discharge shall be completed in 1 hour at an average current of $I = 0{\cdot}1 \times C_5$ A. The charging shall be affected during 5 hours at an average current of $I = 0{\cdot}1\ C_5$ A. Throughout the life test unit, the battery units shall be immersed in a tank of water the temperature of which is maintained at 40 ± 3°C. The battery units shall be so immersed that their top surface shall be not more than 25 mm above the water level in the tank. If several battery units are placed in the same tank, a distance of 25 mm shall be maintained between them. The distance between the battery units and the sides of the tank shall also be 25 mm. Distilled or deionized water shall be added to the cells daily during the life test to maintain the electrolyte at its normal level.

C-5. After the last charge of series of 36 discharge-recharge cycles, the battery units shall be disconnected from the circuit. They shall then remain or open circuit for 96 hours. After this open circuit stand, they shall be discharged at the rapid rate $I = 1 \times C_5$ A or at the higher current specified by the manufacturer. This discharge is continued down to an end voltage of $1{\cdot}5\ \text{V} \times n$. On completion of this discharge, the battery units shall be fully recharged. The combination of discharge and recharge cycles as described above together with 96 hours open circuit period, the rapid discharge and the subsequent recharge form one unit of life test.

C-6. After the final life test unit, the battery unit, shall not be subjected to any test.

APPENDIX D

(*Clause* 7.1)

INFORMATION TO BE GIVEN AT THE STAGE OF ENQUIRY AND SUPPLY

D-1. The following design particulars are required to be supplied by the manufacturer along with the quotation or supply:

a) Make ………

b) Type of unit ………

c) Manufacturer's nomenclature ………

d) Overall dimension of battery unit (length × width × height) ……… mm

e) Weight per battery unit with electrolyte (*see* Table 1) ……… kg

f) Cell container material ………

g) Type of positive plates ………

h) Type of negative plates ………

j) Type of separators ………

k) Maximum electrolyte temperature that the cell/battery will withstand without any damage:

  1) Continuously ……… °C

  2) For a short period ……… °C

m) Electrolyte height above the top of the separators ……… mm

n) Clearance between the plates and the bottom of the container ……… mm

p) Quantity of electrolyte per cell ……… litre

q) Specific gravity of electrolyte for initial filling at 27°C ………

r) Details of initial treatment recommended ………

s) Material of terminal take offs and inter-cell connectors ………

t) Material of inter unit connectors ………

u) Normal charging rate ……… Amperes

APPENDIX E

(*Clause* 7.1)

RECOMMENDED PROFORMA FOR TYPE APPROVAL CERTIFICATE

E-1. Batteries offered according to this standard shall be covered by a type approval certificate from an appropriate authority. All variations in design shall be covered by separate type approval certificates. Following particulars shall be supplied by the manufacturer along with the type approval certificate against any quotation or supply:

a) Air pressure test (*see* **6.5**), mmH_2O

b) Ampere-hour capacity at the 5-hour rate of discharge to a voltage of 1·70 V × n, measured across the terminals, at an electrolyte temperature of 27°C (*see* **6.6**), Ah

c) Ampere-hour efficiency (*see* **6.7**), percent

d) Watt-hour efficiency (*see* **6.7**), percent

e) Test for retention of charge (*see* **6.8**), percent

f) Life test (*see* **6.9**), cycles

g) Storage test (*see* **6.10**), Ah

h) Discharge curves with voltage as ordinate (scale 10 mm to 1 volt) and time as abscissa (scale 30 mm to 1 hour) are to be supplied showing the performance of the cells under 5-hour rate of discharge.

Bureau of Indian Standards

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